Survivability/Vulnerability Information Analysis Center

SURVIAC Bulletin

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SURVIAC is a U.S. Department of Defense Information Analysis Center (IAC) sponsored by the Defense Technical Information Center (DTIC).

RPG Encounter Modeling

By Rodney Stewart, SURVIAC

Since its development, the rocket-propelled grenade (RPG) has been a concern for ground vehicles and infantry. Originally developed during World War II, the RPG has since become one of the most prolific threats in the modern battle space.

The RPG is a portable, shoulder-launched anti-material weapon. It is typically composed of a launcher and an unguided rocket containing a warhead. In most cases, RPGs employ high-explosive anti-tank (HEAT) warheads that use shaped charge technology to penetrate armor. Primary targets for the RPG include personnel, fixed positions, personnel carriers, and tanks. While originally designed to aid infantry engaging armored ground vehicles at close range, necessity and ingenuity, coupled with the weapon's ease of use, have made the RPG a threat to low-flying and hovering aircraft as well.

The Vietnam conflict and the Russian conflict in Afghanistan popularized the use of the RPG against helicopters. This trend has continued to the present day where recent US conflicts in Iraq and Afghanistan have seen the RPG become a favored weapon for insurgents fighting coalition forces. According to the "Study on Rotorcraft Survivability Summary Report" submitted to Congress in October 2009, a substantial number of helicopters encountering RPGs in these conflicts were lost in combat. Clearly, the need exists to model the threat posed by these weapons.

The majority of RPG modeling focuses on vulnerability and seeks to determine whether or not a target can withstand an RPG impact. Models like COVART (Computation of Vulnerable Area Tool), AJEM (Advanced Joint Effectiveness Model), and LS-DYNA have been employed to assess damage from an RPG. To date, however, very little modeling has been performed to determine the susceptibility of targets to the RPG threat.

Assessing the susceptibility of helicopters and ground vehicles to these threats has its benefits and challenges. Being able to model RPG encounters can lead to better tactics for those experiencing an attack and can lead to system design improvements that may reduce the chances of an RPG impact. The challenge in modeling RPG encounters lies in the number of factors involved. A short list of these factors include: the skill of the gunner, inherent errors in the flight of the unguided rocket, weather conditions, and the ability of the pilot/driver to counter the oncoming threat.

The THREAT Simulation

SURVIAC has taken the first steps in modeling target susceptibility to RPGs by developing the Tank and Helicopter RPG Encounter Analysis Tool (THREAT). The purpose of this tool is to assess RPG encounters and return a probability of hit (P_{HIT}) for the scenario. In the model, P_{HIT} depends on the presented area of the targeted system and a set of errors influencing the impact location of the RPG. Overall, THREAT is a zeroth order attempt to tackle RPG encounter modeling. It makes several simplifying assumptions, is data-driven, and uses simple yet proven methodologies to determine P_{HIT}.

The inputs to THREAT describe the target, the RPG, and the encounter between the two.

The user describes the target in terms of two-dimensional boxes representing the presented

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We would like to hear from you. Have we helped you in some way? How can we improve? Would you like to author an article for a future issue? What issues would you like to see discussed in upcoming bulletins? Modeling & Simulation? Homeland Defense/Homeland Security? Space Survivability Issues? Unmanned Aerial Systems? Please e-mail your comments to surviac@bah.com.

RPG Encounter Modeling continued from page 3.

area of the system from a particular attack aspect. THREAT allows the user to specify presented areas for multiple attack aspects; however, only the target data associated with one attack aspect is used in each encounter calculation.

For the RPG, the user defines the accuracy of the threat as well as its maximum range. In THREAT, RPG accuracy is measured in terms of circular error probable (CEP) and is a function of the range between the shooter and the target. The following figure is a plot of the accuracy of the RPG-7, probably the most prolific RPG in the world today. The data in this plot was extrapolated from information found on the web and the TRADOC bulletin, "Range and Lethality of US and Soviet Anti-Armor Weapons".

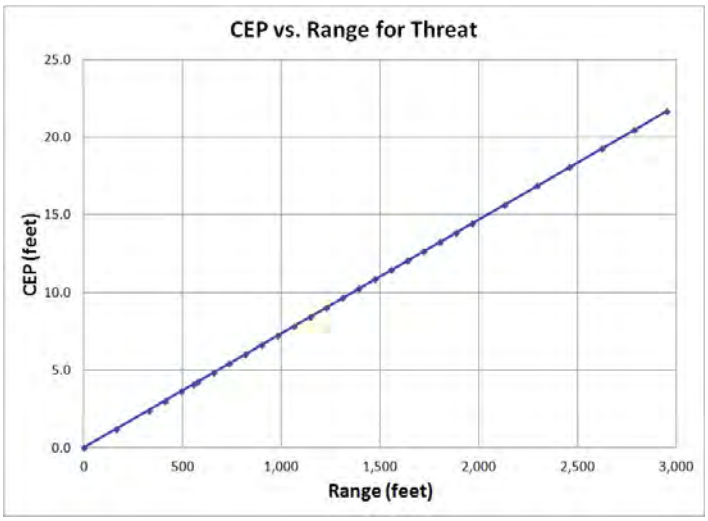

Figure 1: CEP as a Function of Range for RPG-7

Finally, the encounter is described in THREAT in terms of the aim point, range, and attack aspect of the selected RPG. The aim point is measured with respect to the target definition for the chosen attack aspect. The following figure shows a representative encounter for the CH-47. The red boxes in the figure represent sections of the presented area input to THREAT. The blue dot is the desired impact point for the RPG.

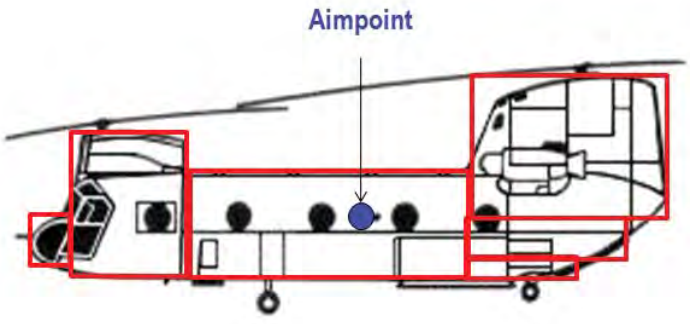

Figure 2: Aim Point on 2-D Representation of a CH-47

The determination of P_{HIT} by THREAT is performed using one of two possible methodologies. The first is a Monte Carlo approach where impact points are sampled using the CEP calculated for the specified range. In this methodology, P_{HIT} is the result of dividing the number of target impacts by the total number of shots.

The second P_{HIT} calculation methodology is a deterministic approach using the ratio of areas. The first step in this methodology is to generate a circle based on the CEP corresponding to the specified range for the encounter. This circle is then divided into annular bins depending on a user-defined cell size. During the creation of these bins, the circular standard error function is used to calculate a P_{HIT} weighting factor for each bin. Next, the target's presented area is divided into cells, and the presented area in each annular bin is tallied. Finally, the ratio of the target presented area in each bin to the total area of the bin is calculated and multiplied by its associated weighting factor to calculate P_{HIT} for the bin. The sum of P_{HIT} across all bins yields the P_{HIT} for the RPG against the target. A figure summarizing this methodology is included below.

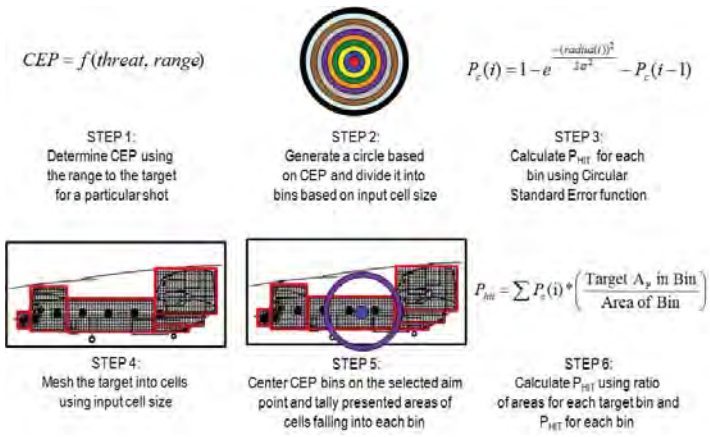

Figure 3: Ratio of Areas Approach

THREAT makes several assumptions in the calculation of P_{HIT}. First, encounters are essentially modeled in two dimensions. Second, THREAT only handles one-on-one encounters, meaning that only one target and one shooter are assessed in each calculation. Third, THREAT assumes that all errors in an RPG encounter can be expressed in terms of CEP as function of range. Lastly, THREAT assumes the shooter has sufficient skill to threaten the specified aim point on the target. These assumptions, while limiting, simplify the scenario to facilitate the calculation of P_{HIT} and point towards areas of future development for the tool.

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SURVIAC Helicopter Study

The THREAT tool was used to conduct a quick study of the RPG-7 against seven helicopters in the US inventory. The RPG-7 was selected due to its proliferation among the world's militaries and terrorist groups. The following helicopters were selected for this study:

- AH-1Q
- CH-47
- MH-60
- OH-58A
- HH-65
- MH-68
- UH-1H

Five of these helicopters, the AH-1Q, CH-47, MH-60, OH-58A, and UH-1H, were selected due to their extensive use. The other two, the HH-65 and MH-68, were selected since their vulnerabilities were recently assessed by SURVIAC.

In the first part of the study, SURVIAC assessed the P_{HIT} as a function of range for the selected helicopters from the front and side. A nominal aim point was selected near the center of geometry for each helicopter, and the range was varied from point blank to the maximum flight distance associated with the RPG-7. The results of this study can be seen in the following figures.

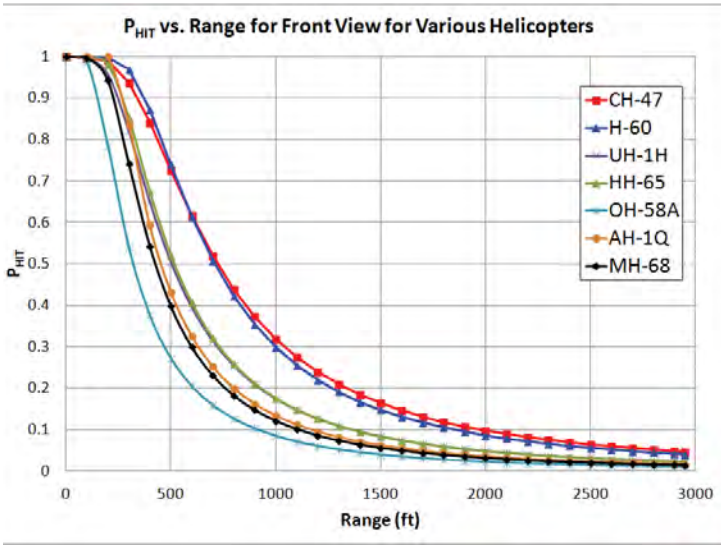


Figure 4: P_{HIT} as Function of Range for Selected Helicopters (Frontal Attack)

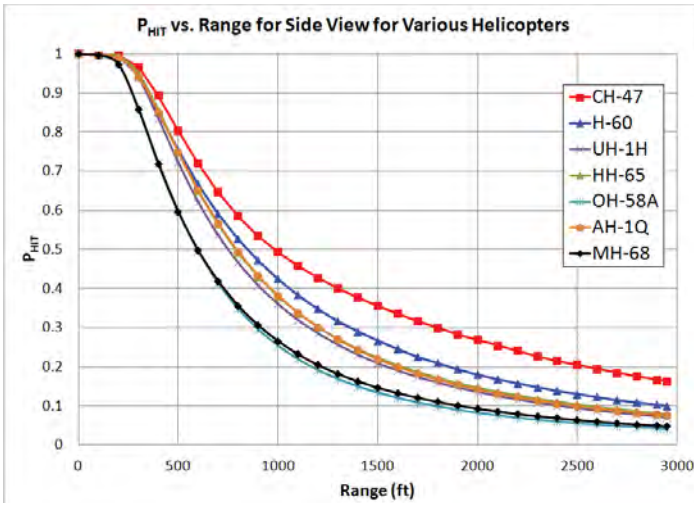


Figure 5: P_{HIT} as Function of Range for Selected Helicopters (Side Attack)

In these plots, it is obvious that target presented area for a particular view drives the calculation of P_{HIT}. From both the front and the side, the CH-47 helicopter has the largest profile and therefore has the largest P_{HIT}. In a similar fashion, the OH-58A has the smallest presented area for both views and yields the smallest P_{HIT} in this study. One other thing to note is how quickly P_{HIT} falls with respect to distance. At a range of 1000 feet, the absolute best performance of the RPG-7 was an impact 50% of the time.

The second part of this study assessed the impact of changing the RPG impact location for the CH-47 and OH-58A helicopters. For this study, the range corresponding to a P_{HIT} equal to 0.5 for each helicopter was selected, and P_{HIT} was determined at various stations along the fuselage. The goal here was to observe the sensitivity between miss distance and P_{HIT}. The results for the CH-47 and the OH-58A are in the following figures.

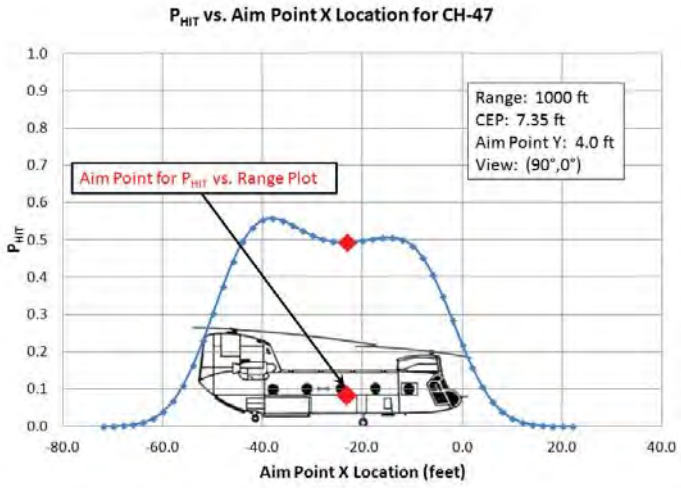


Figure 6: P_{HIT} as a Function of Aim Point Location for CH-47

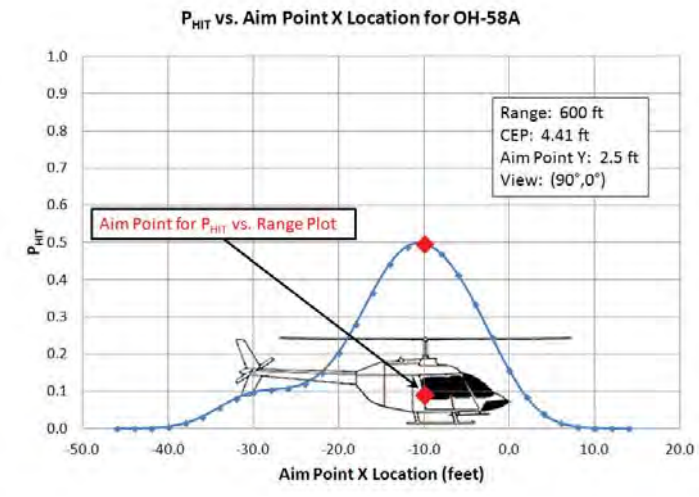


Figure 7: P_{HIT} as a Function of Aim Point Location for OH-58A

These plots demonstrate how the sensitivity of P_{HIT} varies depending on the target. For the CH-47, two peaks in P_{HIT} exist due to the distributed nature of its presented area. On the other hand, the smaller OH-58A has only one peak, and P_{HIT} falls dramatically as one moves away from the center of the helicopter.

Conclusion

SURVIAC has developed a tool that assesses the probability that an RPG will strike a helicopter or tank. Furthermore, SURVIAC has used this tool in an initial study to observe the sensitivity of P_{HIT} for RPGs with respect to range and aim point location. Having this capability opens the door for future assessments of encounters between RPG's and vehicles. Those interested in this tool may contact SURVIAC for more information.

References

Study on Rotorcraft Survivability Summary Report; Couch, M. A.; Joint Aircraft Survivability Program Office, Arlington, VA (2009). (SURVIAC Library No. 28662).

RPG-7. (n.d.). In Wikipedia. Retrieved from http://en.wikipedia.org/wiki/RPG-7

Range and Lethality of US and Soviet Anti-Armor Weapons; US Army Training and Doctrine Command, September 1975.

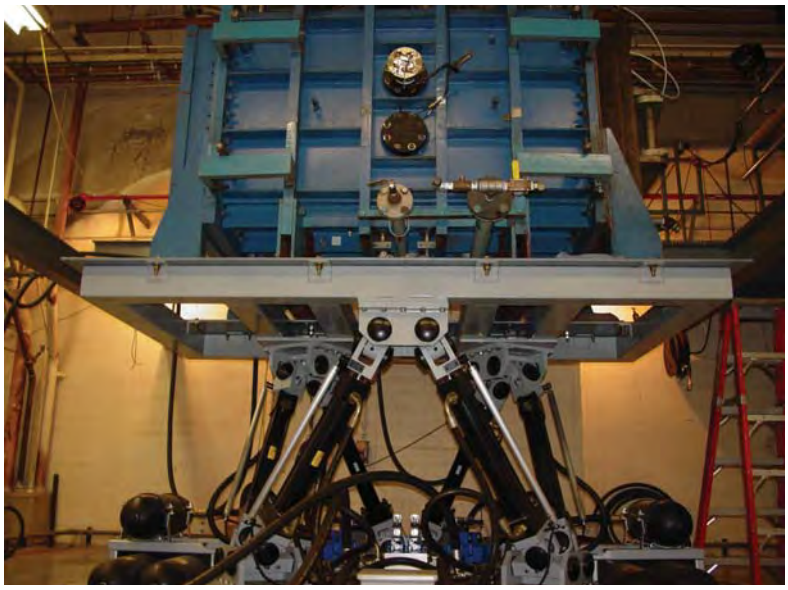
About the Author

Rodney Stewart

Mr. Stewart is an Associate with Booz Allen Hamilton and serves as a modeler and vulnerability analyst for SURVIAC at Wright-Patterson AFB. He has over 9 years of experience in the realm of target vulnerability and weapons lethality modeling. Currently, he supports air vehicle vulnerability analyses and conducts COVART training classes hosted by SURVIAC. Prior to joining SURVIAC, Mr. Stewart was the lead developer of the Computation of Vulnerable Area Tool (COVART). Going further back, he has conducted survivability work for the F-35 project and assessed the lethality of nuclear and conventional submarine-launched ballistic missiles. Mr. Stewart earned his B.S. in Mechanical Engineering from the University of Colorado at Colorado Springs. ■

Motion Simulation and Aircraft Survivability

by John Kemp, Operations Team Lead - 46 Test Group



Testers strive for realism during the execution of planned tests. For example; blowing high speed, quality airflow over a test article adds realistic flight conditions to the assessment, adding JP-8 to the test article instead of water, again adds to the realism of the test. Adding realism to the test produces better quality data with an increased credibility of the results. Testers must find creative, cost effective ways to increase the realism of each and every test. Testing aircraft survivability is no exception, when it comes to adding realism, gains and innovations must be reached for every assessment. One additional way to add realism to testing, not applicable for every test series, is motion simulation. If the test article is moved like the real vehicle does in the field, then motion simulation is applicable for a great number of testing areas and research categories. Tests like fuel sloshing, material durability to sudden changes in direction, evaluating structural stiffness and deflection under lower "g" loads, certifying aircraft repairs under lower "g" loads, and testing objects under flight profiles. The motion simulator is capable of replicating typical flight profiles for a variety of aircraft. Using the motion simulator is less expensive than flight testing and has the potential to reduce costs and scope associated with flight testing, if accomplished prior to flight test.

The figure above shows the motion table in the test range. There is a simulated fuel tank mounted on top of the motion simulation table. Actuators can be seen in the figure and provide the computer controlled inputs. The platform on the motion simulator measures 6' by 9' and can hold up to 2nb5 kips, while performing its designed motion. There are 6 hydraulic cylinders arranged in a hexapod configuration. Following a basic coordinate system the x-axis is to the right, the y-axis into the page and the z-axis straight up. Looking at the figure, the x-axis is the long axis left and right. The z-axis would be up and down in the figure. There are various types of motion produced as the hydraulic actuators push on the table or platform. There is Yaw, Pitch, and Roll, in addition to Surge, Sway, and Heave. Yaw, Pitch and Roll are rotations about the z, y, and x axis respectively. The linear translations called Surge, Sway and Heave are displacements in the x, y, and z directions correspondingly. The table below summarizes the numerical capabilities or parameters of the motion table.

Motion Parameters	Rotations			Translations		
	Yaw	Pitch	Roll	Surge	Sway	Heave
Displacement (in. and deg.)	±40.5	±34	±28	24	20	12
Velocity (in./s and deg./s)	250	15	250	60	60	80
Acceleration (g and deg./s^2)	1500	1500	1500	1.8g	1.8g	1.8g

Survivability related testing and vulnerability reduction issues have practical applications using the motion simulation table. New fuels need to be sloshed on the motion table to check for increased flammability, new aircraft seat ergonomics need to be validated, and new aircraft component designs need evaluations with planned motion to assess their durability and performance, just to name just a few applications. If motion simulation can produce better solutions for testing or ideas are needed about how motion simulation can assist in solution development, please contact John S. Kemp with the 46 Test Group Wright-Patterson AFB at 937-255-6302 or E-mail to 46tg.olac.wpafb@wpafb.af.mil for further strategic information on motion simulation and how this can improve test results. ■

Aircraft Combat Damage Reporting - Forward Deployed Success

By Dave Mullins, SURVIAC

During Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) a joint group of Reserve Air Force, Marine Corps, Navy and Army personnel were deployed to Iraq to begin the process of data gathering on aircraft damaged in combat. This was the first full time deployment for the Joint Combat Assessment Team (JCAT). Overall, the mission to collect battle damage data began during the Vietnam Conflict. Since its inception in December of 1984, SURVIAC's mission has included the collection of combat damage data, and since that time has accumulated over 30,000 incident reports spanning the past 50 years of conflict. These reports have been used over the years as a source of Live Fire Test and Modeling and Simulation data validation, as well as a source of feedback to the Acquisition and Engineering Communities and the Aircraft Survivability Community.

During the most recent conflicts, as more aircraft were hit, crews lost, and new threats appeared, it became clear that the data being collected needed a centralized location for storage and dissemination. JCAT came to SURVIAC with this requirement. Working with the Joint Aircraft Survivability Program Office (JASPO), the Combat Damage Incident Reporting System (CDIRS) was born. This database contains over 1500 high fidelity investigation reports, most containing high resolution images, incident video, crew interviews and mission narratives. CDIRS is used on a daily basis as a bridge between the forward deployed JCAT units and the aircraft survivability community in the United States. As incidents are reported, analysts are able to view quick-look (less than 24 hours since incident occurrence) reports and eventually, the full reports describing in depth, the damage to aircraft, crew, and current threat assessments.

CDIRS began as a simple data collection effort using an FTP site as a file repository for JCAT reports. As the number of reports and requestors grew, it became apparent that an FTP site would no longer suffice and it certainly was not capable of data manipulation and data massaging. A database was needed.

In 2005 the first version of CDIRS was complete but represented more of a proof of concept than production system. SURVIAC worked with various Services and Wright Patterson AFB communication offices to host the server on the SIPRNET and provide initial inputs for requirements for data points to collect. The initial database was available within months but was hampered by low bandwidth capability in theater. SURVIAC worked closely with JCAT during that year to provide solutions to the bandwidth issues in Iraq, but mailing a CD/DVD proved to be the most efficient way of getting large amounts of data out of theater.

Over the next two years, SURVIAC worked on several updates to this system, bringing requirements under control and managing the level of expectation for the granularity of data being collected. The reporting requirements started to become onerous to the personnel in theater and filling out a form with 80+ data points took far too long. An overhaul of the system was needed

Starting in 2008, SURVIAC set out to build version 2.0 of the CDIRS database. The database was reexamined and greatly improved. With an eye toward simplification, the system was rebuilt from the ground up, providing multiple search capabilities. It also provided cleaner data entry forms and capability for future growth. Organizations throughout the DoD have been able to access CDIRS reports, providing vivid, real-time data for Research and Development efforts, survivability improvements and feedback for Original Equipment Manufacturers (OEMs) and program offices. The reports have been used for a variety of programs including the Hostile Fire Detection System, the Common Missile Warning System, the Large Aircraft Vulnerability Study, the Study of Rotorcraft Survivability and the ongoing effort to bring down the risk of crew causalities among aircrews in damaged aircraft.

About the Author

David Mullins
Mr. Mullins is an Associate with Booz Allen Hamilton working for the SURVIAC since June 2002. During that time he has worked on a variety of information systems related to Aircraft Combat and Survivability and contract management. He was one of the original software developers on the first iteration of CDIRS and now leads a team of IT professionals covering a range of applications throughout the DoD. He has a bachelor's degree in Management Information Systems from Wright State University. ■

Recent SURVIAC Task Awards

- DO 0439 - Perform research and development in order to complete/deliver critical infrastructure facilities assessments; strategic planning technical reports; and experimentation, wargaming and exercise technical reports for the III Marine Expeditionary Force.

- DO 0441 - Perform research and development in order to complete and deliver survivability and vulnerability reports for the Air Force Intelligence, Surveillance, Reconnaissance Agency Weapon System's Office to enhance the enterprise's ability to improve the effectiveness of technology assessments, developments, and evaluations.

- DO 0452 - Complete/deliver the assessment of Army warfighting challenges and integrated learning plans, the experiment final reports, and experiment-to-action plans. The U.S. Army will use these reports to develop and revise Army concepts and contribute to other services and joint concepts; make recommendations for the development of Army and joint capabilities development scenarios; research current and future warfare through experimentation; and build models and simulations to test new warfighting ideas.

SURVIAC Bulletin Correction

In the last edition of the SURVIAC Bulletin, we outlined the creation of a unique website documenting historical efforts by various branches and departments of the U.S. military to develop nutritious food for the warfighter ("USARIEM Partners with SURVIAC to Develop Military Nutrition Website," SURVIAC Bulletin Issue 1, 2011). The article focused primarily on the creation of the website for the United States Army Research Institute of Environmental Medicine (USARIEM), and neglected to highlight another closely related organization whose expertise and innovation have proved invaluable in development and testing of military rations. We regret this oversight. To provide a more complete picture of the work being done, we have invited the U.S Army Natick Soldier Research, Development & Engineering Center's Combat Feeding Directorate (NSRDEC CFD) to highlight their extensive research and development efforts on behalf of the warfighter, in the next issue of the SURVIAC Bulletin.

- DO 0444 - Perform research and development in order to complete and deliver the capability evolution description document; the system prototype report; and the test and evaluation master plan. The Navy will use these reports for investment decisions regarding potential technologies that can best protect warfighters from threats posed by technological warfare, natural disaster, biochemical warfare, and terrorism/insurgency.

- DO 0428 - Complete/deliver the Asymmetric Warfare/Counter-Improvised Explosive Device Equipment Capability Report; Electronic Warfare and Counter Remote-Controlled Improvised Explosive Device Electronic Warfare Analysis of Processes and Procedures Report; and Search Policy Procedures Document Review and Analysis Report.

- DO 0423 - Provide research, data collection, and technical analysis to assess U.S. Southern Command's strategic planning process, design metrics to measure theater security objectives, and perform analyses to assess command performa nce against defined metrics.

- DO 0449 - Perform research and development in order to complete and deliver the "Emerging Leading-Edge Technological Advancement of Intelligence Surveillance Recon Capabilities Report", "Tactics, Techniques, and Procedures Report" and wargame/exercise lessons learned reports to be used to ultimately increase the situational awareness and survivability of the warfighter by helping them to better identify battlefield threats.

- DO 0425 - research and development in order to complete and deliver survivability and vulnerability reports including Weapons Materials Research Directorate Technology Information Report, Systems Integration Analysis and Scientific and Technology Roadmap for Warfighter Enterprise, and Experimental Tests and Test Planning and Reports. These deliverables provide assessments of emerging technology needed to defeat specific threats such as improvised explosive devices and rocket propelled grenades. ■

Source: www.defense.gov/contracts

Models Distributed by SURVIAC

The Survivability/Vulnerability Information Analysis Center (SURVIAC) is a U.S. Department of Defense Information Analysis Center (IAC) sponsored by the Defense Technical Information Center (DTIC)

Acronym	Model Name	Version No.
AIRADE	Airborne Radar Detection Model	7.4
ALARM	Advanced Low Altitude Radar Model (Includes EARCE 3.4)	5.4
BLUEMAX 5	Variable Airspeed Flight Path Generator	1.0.2
BRAWLER	Air-to-Air Combat Simulation	7.4
ESAMS	Enhanced Surface-to-Air Missile Simulation	4.3
FPM	Fire Prediction Model	3.8.2
IVIEW 2000	Graphical User Interface for Output Simulation	1.0E
JSEM	Joint Service Endgame Model	1
LELAWS	Low Energy Laser Weapons Simulation	3.0
RADGUNS	Radar-Directed Gun System Simulation	2.4.1
Vulnerability Tool Kit	Contains: BRL-CAD 7.14.8 (Ballistic Research Laboratory Computer-Aided Design Package), COVART 6.2 (Computation of Vulnerable Area Tool), FASTGEN 6.1 (Fast Shotline Generator), and FATEPEN 3.1.1 (Fast Air Target Encounter Penetration Program)	

For further information on how to obtain these models and how to establish need-to-know certification, please contact SURVIAC at (937) 255-3828 or DSN 785-3828. Requests from non-U.S. Agencies must be forwarded to their country's Embassy in Washington, DC, Attention: Air Attache's Office.

The Joint Aircraft Survivability Program (JASP) is sponsoring a four-day Aircraft Combat Survivability Short Course to be held 15-18 May 2012. The Naval Postgraduate School Center for Survivability and Lethality will host the course on campus at Monterey, California. The course is open to Government and Industry personnel who are interested in learning more about the aircraft combat survivability discipline and have a need-to-know. The course is a familiarization in Aircraft Combat Survivability. It is suitable for engineers and other personnel involved in aviation-related programs. Much of the course is intended to be unclassified, and the student will receive an unclassified binder with course notes and a complimentary copy of Dr. Robert E. Ball's text The Fundamentals of Aircraft Combat Survivability Analysis and Design, 2nd Edition. A broad spectrum of topics will be discussed including:

- Introduction to survivability
- Historical and current survivability combat data
- Platform-specific aspects of survivability
- Modeling and Simulations for survivability
- Mission and Campaign survivability analysis
- Current vulnerability and susceptibility reduction technology focus areas
- Joint Live Fire for aircraft systems and Live Fire Test
- Personnel casualties and safety
- IR and Radar Fundamentals
- Electronic Warfare

Products Distributed by SURVIAC

The Survivability/Vulnerability Information Analysis Center (SURVIAC) is a U.S. Department of Defense Information Analysis Center (IAC) sponsored by the Defense Technical Information Center (DTIC)

Product	Cost
A Critical Review of Graphite Epoxy Laser Damage Studies	Free
A Summary of Aerospace Vehicle Computerized Geometric Descriptions for Vulnerability Analyses	Free
Advanced Materials for Enhanced Survivability	Free
Aircraft Combat Occupant Casualty Assessment State-of-the-Art Report (SOAR)	$ 50.00
Aircraft Combat Survivability Self Study Program (SSSP) CD (or download from SURVIAC website)	Free
Aircraft Fuel System Fire and Explosion Suppression Design Guide	Free
“Aircraft Survivability” Video	Free
Alternatives for Halon 1301 in Ground Vehicle Firefighting Systems	$ 50.00
An Overview of Laser Technology and Applications	Free
An Overview of Laser-Induced Eye Effects	Free
Aircraft Asymmetric Threat Survivability Workshop **Summary** Report	Free
Aircraft Asymmetric Threat Survivability Workshop Report (Full Report)	$ 50.00
“Battle Damage Repair of Composite Structures” Video	Free
Collection of Vulnerability Test Results for Typical Aircraft Systems and Components	$ 75.00
Comparative Close Air Support Vulnerability Assessment Study - Executive Summary	Free
Component Vulnerability Workshop Component Pd/h Handbook	$200.00 (Free to Gov’t)
Component Vulnerability Analysis Archive (CVAA) and Workshop Notes	$300.00 (Free to Gov’t)
Component Vulnerability Database Development	Free
Computerized Geometric Information to Support Vulnerability Assessments State-of-the-Art Report	$ 75.00
Continuity of Operations (COOP) State-of-the-Art Report (SOAR)	$ 50.00
Countermeasures Handbook for Aircraft Survivability	Free
Critical Review and Technology Assessment (CRTA) for Soldier Survivability (Ssv)	Free
“Designing for Survivability” Video	Free
Directed Energy Effectiveness Modeling State-of-the-Art Report (SOAR)	$ 50.00
DREAM Sensitivity Study	$ 50.00
“Fundamentals of Ground Combat System Ballistic Vulnerability/Lethality” by Dr. Paul Deitz	Free - Gov’t only*
Gas Explosion Suppression Agent Investigation	$200.00
Joint Aircraft Survivability Program (JASP) Promotional Video	Free
Lessons Learned from Live Fire Testing	$ 50.00 (Free to Gov’t)
MANPADS Threats to Aircraft: A Vulnerability Perspective, February 2000, Final Report	$200.00
Missile Warhead Bomb and Propellant Response State-of-the-Art Report (SOAR)	$ 50.00
MOSAIC Sensitivity Study	$ 50.00
Munition Response State-of-the-Art Report (SOAR)	$ 50.00
National MANPADS Workshop: A Vulnerability Perspective, Proceedings - 2 volumes	$200.00
Night Vision Goggle (NVG) Rocket Propelled Grenade (RPG) Quick Look Report (QLR) CD	$ 50.00 (Free to Gov’t)
Penetration Characteristics for Advanced Engine Materials	Free
Proceedings of the Eighth DoD Conference on DEW Vulnerability, Survivability, and Effects - 2 Volumes	$100.00 / per set
RADGUNS 1.8 Parametric Study	$100.00 (Free to Gov’t)
Ship Survivability Overview	Free
SOAR on Directed Energy Weapon (DEW) Assessment Methods	$ 50.00
State-of-the-Art (SOAR) for Non-Lethal Weapon (NLW) Assessment Methodologies	$ 50.00
“SURVIAC - A Capabilities Overview” Video	Free
SURVIAC Model Guide	Free
Survivability Analysis Workshop Notebook 2005	$100.00
“The Fundamentals of Aircraft Combat Survivability Analysis and Design” second edition, by Robert E. Ball	Free - Gov’t Only*
“Threat Effects in Aircraft Combat Survivability” Video (2006)	$ 50.00 (Free to Gov’t)
UAV Survivability Enhancement Workshop **Summary** Report	Free
UAV Survivability Enhancement Workshop Report	$ 50.00
Vulnerability Reduction Workshop **Summary** Report	Free

For further information on how to obtain these products and how to establish need-to-know certification, please contact SURVIAC at (937) 255-3828 ext. 284 or DSN 785-3828 ext. 284. Requests from non-U.S. Agencies must be forwarded to their country’s Embassy in Washington, DC, Attention: Air Attache’s Office.

Calendar of Events

MARCH 2012

28th Annual National Test and Evaluation Conference
12-15 Mar 2012
Hilton Head, SC
POC: NDIA, Allison A. Doherty, (703) 247-2570
E-Mail: adoherty@ndia.org
http://www.ndia.org/meetings/2910/Pages/default.aspx

21st Behavior Representation in Modeling & Simulation (BRIMS) Conference 2012
12-15 Mar 2012
Amelia Island, FL
POC: Lodestar Group, (919) 573-6108
E-mail: info@brimsconference.org
http://brimsconference.org

2012 MSS Battlefield Survivability and Discrimination (BSD)
12-15 Mar 2012
Pasadena, CA
POC: SENSIAC, Matthew Antico, (404) 407-8379
E-mail: matthew.antico@dlpe.gatech.edu
https://www.sensiac.org/external/mss/meetings/list_meetings.jsf

Combat Systems Symposium 2012
26-27 Mar 2012
Arlington, VA
POC: American Society of Navel Engineers (ASNE)
(703) 836-6727
E-mail: asnehq@navalengineers.org

2012 Joint Undersea Warfare Technology Spring Conference
26-29 Mar 2012
San Diego, CA
POC: NDIA, Kimberly Williams, (703) 247-2578
E-Mail: kwilliams@ndia.org
http://www.ndia.org/meetings/2260/Pages/default.aspx

2012 DTIC Conference
26-29 Mar 2012
Fort Belvoir, VA
POC: DTIC, http://www.dtic.mil/dtic/annualconf/2012/DTICConf.html

2012 Symposium on LPI Radar, Counter LPI, & ELINT Receiver Technologies
27-29 Mar 2012
Monterey, CA
POC: AOC, events@crows.org
http://www.crows.org/details/162-low-probability-of-interceptelint-conference.html

APRIL 2012

2012 AAAA Annual Professional Forum and Exposition
1-4 Apr 2012
Nashville, TN
POC: AAAA , http://www.quad-a.org

Directed Energy Systems Symposium
2-6 Apr 2012
Gaithersburg, MD
POC: DEPS, Cynnamon Spain, (505) 998-4910
E-mail: Cynnamon@deps.org
http://www.deps.org/DEPSpages/DESystems-Symp12.html

Marine Corps Systems Command (MCSC) Program Executive Officer, Land Systems 2012 APBI
30 Apr-2 May 2012
Norfolk, VA
POC: NDIA, Meredith Geary, (703) 247-9476
E-mail: mgeary@ndia.org
http://www.ndia.org/meetings/2900/Pages/default.aspx

MAY 2012

AHS 68th Annual Forum & Technology Display "Steering Vertical Flight Technology in New Directions"
1-3 May 2012
Fort Worth, TX
POC: VTOL, 1-855-247-8865, E-mail: staff@vtol.org

6th Annual SpecOps Warfighter Expo WEST 2012
8-10 May 2012
Joint Base Lewis-McChord, WA
POC: Lodestar Group, http://www.specopswest.com

Joint Armaments Conference, Exhibition & Firing Demonstration
14-17 May 2012
Seattle, WA
POC: NDIA, Kelly A. Seymour, (703) 247-2583
E-mail: kseymour@ndia.org
http://www.ndia.org/meetings/2610/Pages/default.aspx

2012 Insensitive Munitions and Energetic Materials Technology Symposium
14-17 May 2012
Las Vegas, NV
POC: NDIA, Julie Veldkamp, (703) 247-2577
E-mail: jveldkamp@ndia.org
http://www.ndia.org/meetings/2550/Pages/default.aspx

56th Annual NDIA Fuze Conference
14-16 May 2012
Baltimore, MD
POC: NDIA, Cindy Lynn Moore, (703) 247-2540
E-mail: cmoore@ndia.org
http://www.ndia.org/meetings/2560/Pages/default.aspx

JASP Aircraft Combat Survivability Short Course
15-18 May 2012
Monterey, CA
POC: SURVIAC, Paul Jeng, (937) 255-3828
http://www.bahdayton.com/jaspsc

2012 Test Instrumentation Workshop
15-18 May 2012
Las Vegas, NV
POC: ITEA, (703) 631-6220
http://itea.org/files/2012/2012_test_instr_ws.asp

2012 Special Operations Forces Industry Conference (SOFIC)
22-24 May 2012
Tampa, FL
POC: NDIA, Meredith Geary, (703) 247-9476
E-Mail: mgeary@ndia.org
http://www.ndia.org/meetings/2890/Pages/default.aspx

JUNE 2012

Military Rotorcraft
6-8 Jun 2012
Washington, DC
POC: TTC
http://www.ttcus.com/view-conference.cfm?id=148&CFID=92348798&CFTOKEN=77478168

JULY 2012

3rd Annual Integrated Air and Missile Defense Symposium
12 Jul 2012
Laurel, MD
POC: NDIA, Kimberly Williams, (703) 247-2578
E-mail: kwilliams@ndia.org
http://www.ndia.org/meetings/2100/Pages/default.aspx

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